REMARKS

Claims 28-35 are pending in the application. Of these, claims 28 and 29 are allowed and the remainder are rejected.

Claim Rejections under 35 USC 103

Claims 30-32 are rejected under U.S.C. 103(a) as being unpatentable over Chu et al. (US 5,890,055) in view of Runyon (US 5,966,102).

Claims 30 and 31 are amended, claim 32 is cancelled.

The present invention relates to wireless communication, and to a method and a transmission system for improving performance, capacity and coverage. The quality of a communication link depends on the signal to noise ratio, and that can be improved with the use of diversity. Diversity requires two or more antenna systems, and therefore it is usually implemented at the base station. The mobile unit itself should be simple and inexpensive.

Receive diversity at the base station involves receiving two uncorrelated replicas of the mobile single transmitted signal. If the receive antennae are spaced apart we have space diversity, and if they are of different polarizations we have polarization diversity. The two polarizations could be of any angle relative to each other, but ideally they should be orthogonal (e.g. vertical and horizontal, or at $+45^0$ and -45^0 etc.). This involves adding hardware to the base station but does not affect the signal transmitted to the base station.

For the signal transmitted to the mobile device, transmit diversity can be used (at the base station) by transmitting two replicas of the signal. Depending on the antennae, space diversity or polarization diversity can be implemented. In both cases, the mobile unit has a single receiver which processes the combined signal.

A signal is polarized in the direction of the transmitting antenna, relative to the receiving antenna. Cellular antennae are usually vertical, and the resulting transmitted signal is therefore vertically polarized. It is preferable and more efficient that the transmitting and receiving antennae are both of identical polarization. In other words, both antennae should be installed at the same angle, usually vertical. If the transmitter antenna is not installed at an identical angle to the receiving antenna, polarization occurs, and some of the signal is lost. The base station (or repeater)

antenna is easily controlled and can be kept vertical at all times. The mobile unit antenna cannot be controlled, and it is almost always tilted when in use, (usually about 20 degrees to the vertical).

As mentioned earlier, one of the problems with communication systems is "signal to noise ratio". Since it is desirable for cellular operators to cover a maximum area with minimum resources, repeaters are widely used. A repeater is a device which receives a signal which is usually weak, from a remote transmitter, amplifies and resends the signal either directly to the intended receiver or to another repeater. Repeaters thus effectively increase the range of a transmitter.As repeaters strengthen the signal, the signal to noise ratio is improved.

Claim 30 is amended to state that the method repeats a polarized signal by retransmitting a received polarized signal with the same degree of polarization as the received signal.

Claim 30 defines a method for repeating a randomly polarized signal, where the entire signal (i.e. both the vertically polarized component and the horizontally polarized component) is utilized and not just one of the polarized components, and hence the entire signal is reproduced faithfully, and the original polarization is retained. (In a polarized signal, the higher the degree of horizontal polarization of a transmitted signal, the smaller will be the signal received by a vertical antenna. The horizontally polarized component is not received by a vertical antenna, and is therefore not utilized.)

A mobile device normally sends signals to a repeater, and the repeater then retransmits the signal to a base station, possibly amplifying it. The same method is used in the opposite direction, where the base station transmits a signal to a repeater, and the repeater then retransmits the signal to the mobile device, possibly amplifying it.

Usually, the repeater is located between the mobile device and the base station although sometimes a mobile device is may be situated ***between*** the repeater and the base station, closer to the repeater, the repeater making use of its stronger (and longer range) transmissions to reach the base station which is beyond the transmission range of the mobile device. Another scenario may be when an obstacle seperates a mobile device from a base station, and a repeater is placed to the side of the base station to circumvent the obstacle.

As previously explained, an antenna of a mobile device is seldom positioned vertically and hence signals transmitted from it are polarized relative to the normally vertical antenna of the repeater. A polarized signal may be represented by two components, usually a vertical component and a horizontal component. When prior art repeaters employ a single vertical antenna to communicate with a mobile device, the horizontal component of the signal to and from the mobile device is generally lost. The retransmitted signal is therefore not polarized identically to the received signal. By contrast, with the invention, the retransmitted signal is polarized as the received. When a repeater according to the present claims as amended receives two components of the signal with different polarization, both of them are retransmitted at the same polarization.

Claim 30 defines a method in which a repeater receives and transmits polarized signals by "repeating" seperately both the vertical and the horizontal components of the polarized signal so that the entire signal, i.e. both polarized components of the signal are utilized, and the polarization is retained.

Chu et al describes a communication system with repeaters and frequency translations (or band changing) from PCS to MM-wave and vice versa. In other words Chu defines a repeater that communicates with a mobile device in one direction using telephony (PCS) bands, and communicates with the base station in the other direction using MM-wave.

Chu does not address the problem, let alone the solution, of full utilisation of polarized signals, and the resulting faithful reproduction of the polarized signal, as does claim 30 of the present invention.

Runyon et al teaches a planar array antenna with radiators, dual polarization states and polarization control network (PCN), beam forming networks (BFN) etc. which can control the polarization states of received and transmitted signals. In other words, Runyon teaches a single, complex antenna with capabilities of receive and transmit diversities.

Claim 30 defines the solution to the problem of not fully utilizing polarized signals, and not retaining the polarization relationship between sent and received signals. Signal polarization is caused by the random angle of the mobile device antenna. If both the mobile antenna and the repeater antenna were verical, there would be no polarization of the signals passing between them.

Although by using two of Runyon's antennae with Chu's repeater it is theoretically possible to deal with the problem of polarization of mobile antennae signals, the method of claim 30 is not obvious and not even suggested by Runyon. Neither Chu nor Runyon mention or deal with the problem of retaining the signal polarization between the donor side and the subscriber side.

Combining Runyon's antennae with Chu's repeater will not produce the present invention as defined in claim 30, as claim 30 defines a repeater which retains signal polarization, thus making the repeater appear "transparent". Combining Runyon's antennae with Chu's repeater will produce a repeater operating in two different frequencies and using Runyon's two complex and expensive antennae, without any polarization retention. Chu's and Runyon's repeater can provide various diversities using a single transmitter for each antenna. However, it does not retain the polarization of the repeated signal, as neither Chu nor Runyon define a method of repeating a signal while retaining its polarization.

Clearly, without the disclosure of the present application, the repeater of Chu and Runyon does not address or solve the problem of communicating efficiently with a randomly polarized antenna of a mobile device, or faithfully reproducing its signal with retained polarization.

Claims 31 and 32 are believed to be allowable as being dependent on claim 30.

Claim 33 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chu et al in view of Reudink (US 5,648,968).

Claim 33 was amended to specify that the repeater is configured to retain the relationship between signals passing between the donor side and the subscriber side.

Claim 33 teaches a repeater with a donor side and a subscriber side, both sides using a plurality of transceiver elements for signals in a non-correleted manner. The repeater also amplifies transmitted signals. Incoming signals and outgoing signals are deversified identically so the repeater appears transparent.

As already mentioned, Chu teaches a repeater employing frequency changes, and does not address the problem of non-correlated manner signals, of any diversity.

Reudink teaches a multibeam antenna system with different delays to different narrow beams. A control system determines which of the beams will

transmit each signal, based on the relative strength of the received signals. (see Ruedink's abstract).

The purpose of such an antenna is to increase gain and reduce interference by selecting an appropriate narrow beam for a specific user. Reudik mentions the problem of non-correlated signal transmission in a context far removed from what is claimed in claim 33. Reudik mentions the word "uncorrelated" in the context of antannae spacing and seperation. Claim 33 does not deal with antennae spacings or seperation. Claim 33 addresses the totally different issue of non-correlated signals that are received and transmitted by a repeater, where incoming signals and the outgoing signals are non-correlated in exactly the same manner, thus making the repeater appear transparent to both sides using the repeater, these sides normally being a base station and a mobile device.

Combining Chu and Reudink will produce a repeater with multiple narrow beams. The repeater of Chu and Reudink does not receive and transmit non-correlated signals that are identically non-correlated ,and will not appear fully transparent to both sides using the repeater, as diversities are not retained. Clearly, this is totally different from claim 33 which defines a seemingly transparent repeater receiving and transmitting signals in an identically non-correlated manner. I.e. a repeater which is configured to retain the relationship of signals passing between the donor side and the subscriber side.

In view of the foregoing, it is submitted that all the claims now pending in the application are allowable over the cited reference. An early Notice of Allowance is therefore respectfully requested.

Respectfully submitted,

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